LODDON GARDEN VILLAGE

Hydrogeological Conceptual Model & Risk Assessment

ENV-21960

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1 INTRODUCTION

1.1.1 RPS has been commissioned to prepare a hydrogeological conceptual model and risk assessment to quantify the impact on water environment receptors for a residential development being promoted by Savills at Hall Farm near Reading.

1.1.2 The proposed works are for a residential and mixed-use development, which is expected to be comprised of up-to 2,800 dwellings, employment space, two primary schools, a secondary school, a district centre, local centre, a country park, Suitable Alternative Natural Greenspace (SANG) and green infrastructure and associated strategic infrastructure including drainage and engineering works.

1.1.3 Residential and commercial development is to be focused on the south side of the river Loddon to avoid flood risk constraints. Excluding a spine road connecting to the B3270 there will be no development north of the Loddon.

1.1.4 A walkover survey of water features within the site boundary and within 1km “the survey area” was undertaken from the 2nd to the 4th of June 2025 to identify water environment receptors that may be impacted by the proposed development.

1.1.5 The desk study was undertaken by reference to information provided / published by the following bodies:

- British Geological Survey (BGS);
- Multi-Agency Geographic Information for the Countryside (MAGiC); and
- Ordnance Survey (OS).

2 SITE SETTING

2.1.1 The site is located immediately east of Shinfield, and 2km west of Wokingham. The approximate area of the site is 414 ha. The site boundary, and the surrounding survey area are included as Figure 1 below.

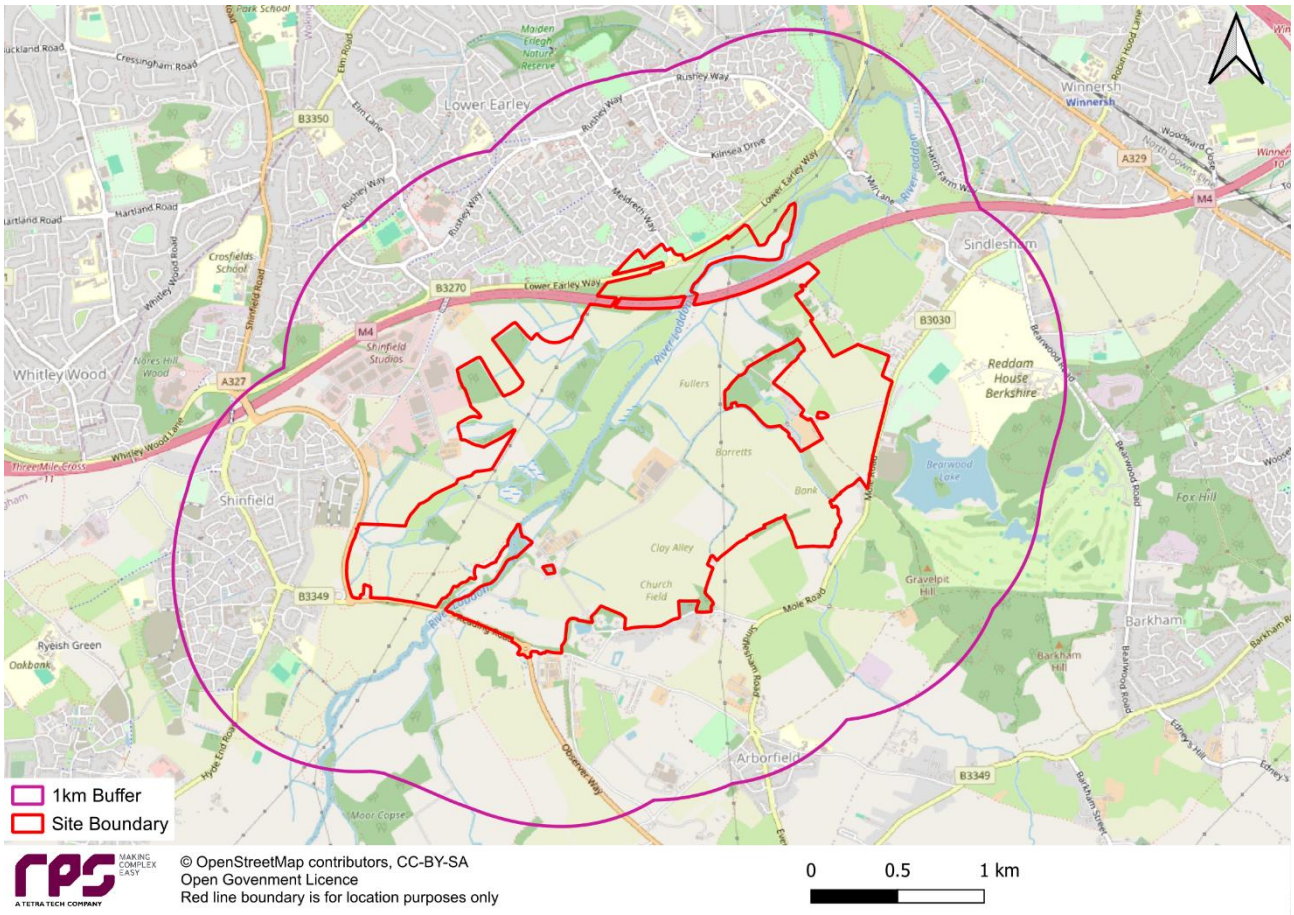

Figure 1 - Site Boundary and Survey Area

2.2 Topography

2.2.1 The site lies entirely within the valley of the River Loddon. The valley is oriented SW-NE. Surrounding land slopes into the valley from the northwest and southeast of the site, from an elevation of 80.9m AOD in the NW and 81.6m AOD in the SE to approximately 39m AOD in the valley.

2.2.2 In the SE of the site, there is another valley, which runs SE-NW and is associated with Barkham Brook. Due to this topography, surface and groundwater flow will be regionally into the valley and to the northeast. The topography of the site is included as Figure 2 below.

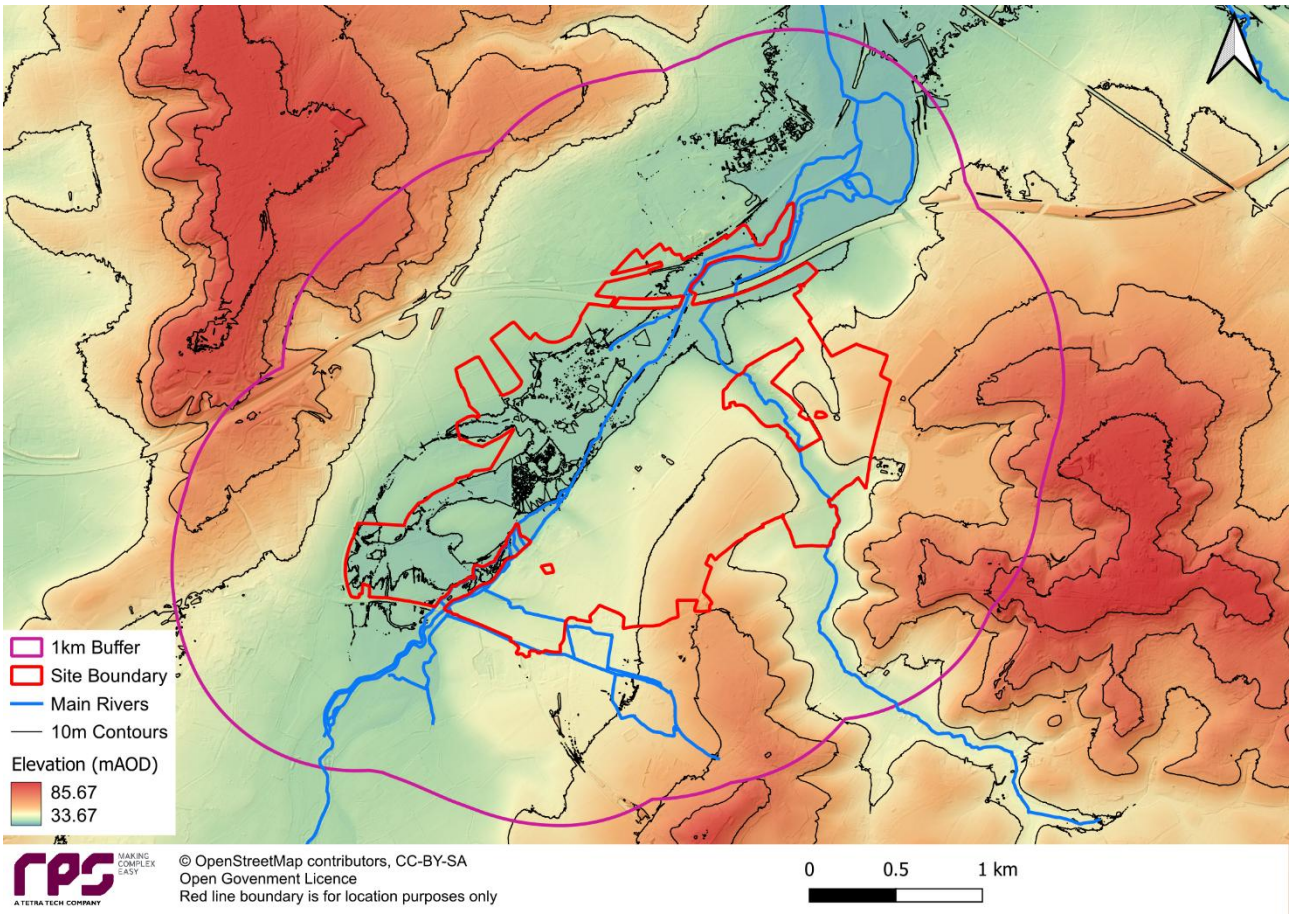

Figure 2 - Local Topography

2.3 Hydrology

2.3.1 Hydrology in the survey area is dominated by the River Loddon to which the three other main rivers drain. Established watercourses within the survey area are generally characterised as medium to large lowland streams that have undergone historic realignment to support milling.

2.3.2 Smaller watercourses, particularly within the site boundary are mostly seasonal flood channels that do not support watercourse ecosystems or have established morphological regimes. There are several areas of wetland, particularly around the Loddon which appear to be fed by groundwater and inundation during flood events. Two large lakes are present to the east of the survey area which provide irrigation water to the adjoining Golf Club. The hydrology of the site is detailed in Figure 3.

2.3.3 Occurrence of springs within the survey area is limited due to the clay dominated geology. Two springs were identified using Ordnance Survey mapping however neither were accessible during the site survey. One near Upperwood Farm to the north of the site and another within the grounds of the golf course near Bearwood Lake, appearing to correlate with the lithology boundary between the Bagshot Beds and London Clay.

2.3.4 Several ponds and lakes were identified within the survey area, none of which are within the site boundary. Most of the ponds sit directly on the London Clay or are lined where more permeable superficial deposits are present.

2.3.5 Five areas of established wetland or water dependant habitat were identified in the survey area, all within the site boundary and within the corridor of alluvium around the Loddon. The wetlands are mostly of freshwater marshes with some areas of wet woodland.

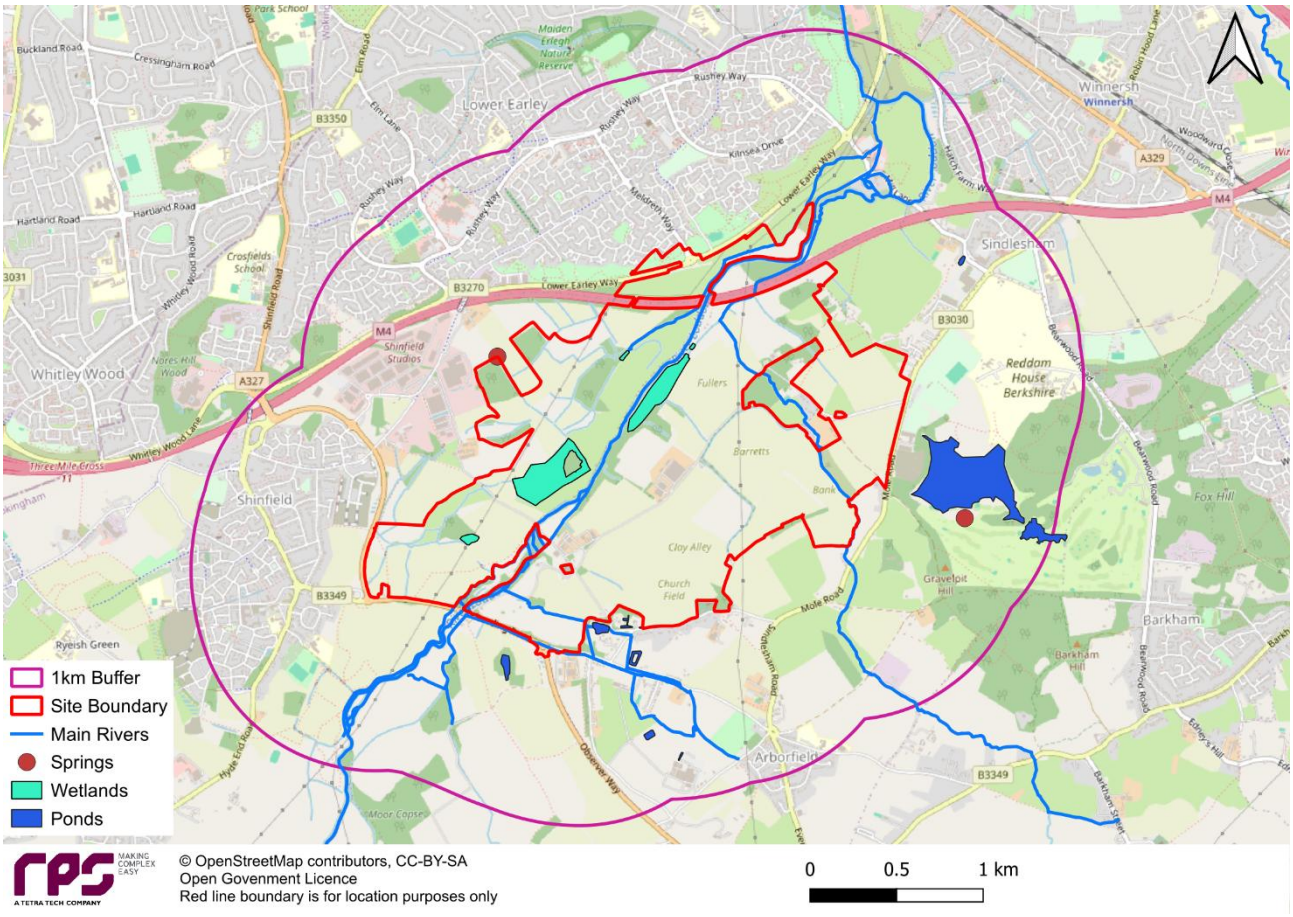

Figure 3 - Hydrology in the Survey Area

2.4 Geology

2.4.1 The BGS Geological Map of Reading (BGS, 2000) has been used to analyse the geology at the site, alongside borehole records mentioned below.

2.4.2 Superficial deposits at the site include alluvium, which runs along the River Loddon and Barkham Brook. West of the Loddon lies the Brickearth Formation, comprising clay, silt and sand, and on all sides River Terrace Deposits are found. River Terrace Deposits comprise sand and gravel, possibly with lenses of silt, clay or peat.

2.4.3 Generally, these superficial deposits can be described as sandy, with some silt and clay, and are likely to be permeable in nature. The River Terrace deposits are classed as a Secondary (A) Aquifer, while the Brickearth Formation is classed as a Secondary (B) Aquifer. Superficial geology is displayed in Figure 4.

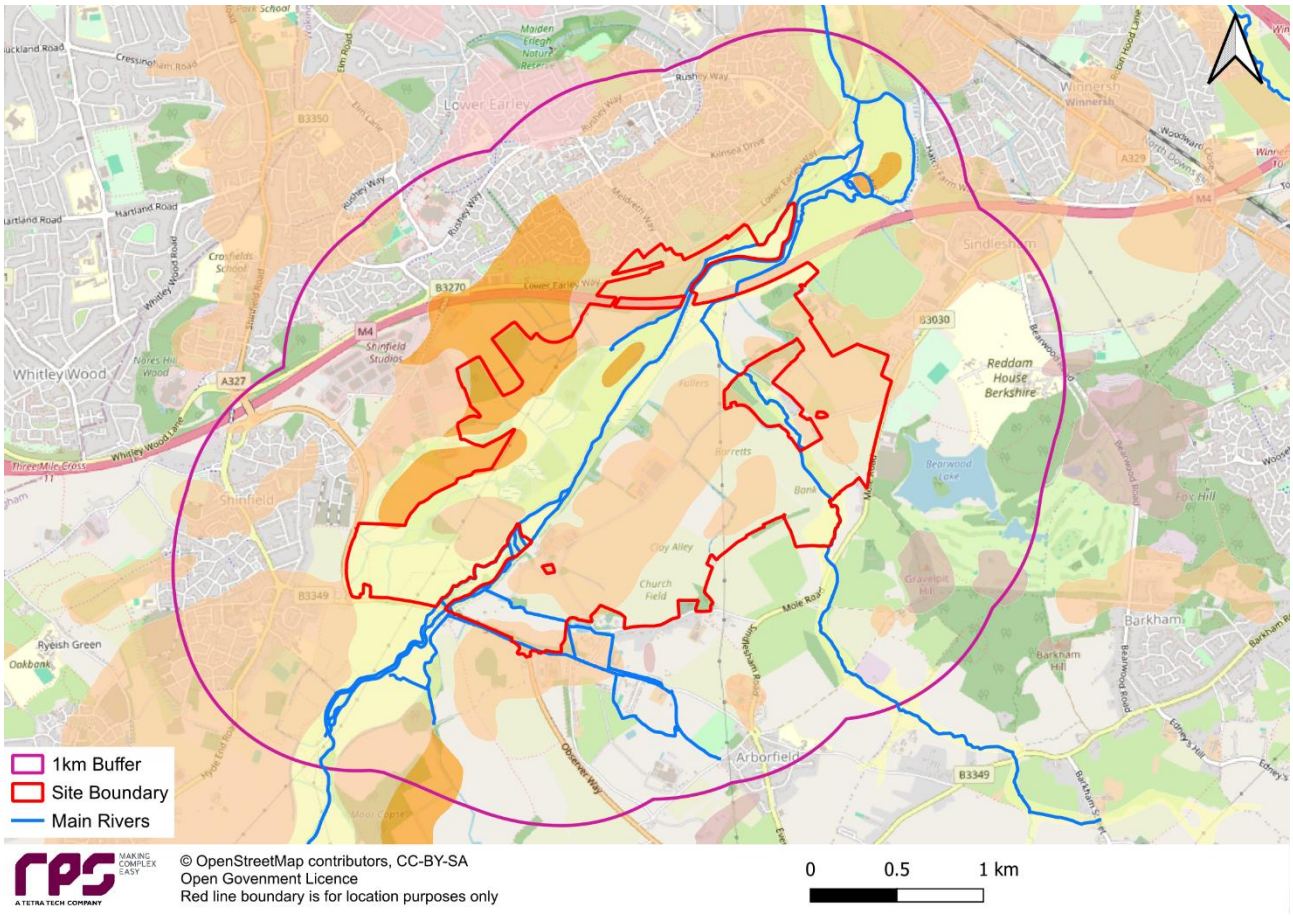

Figure 4 - Superficial Geology

2.4.4 The entirety of the site is underlain by clays, silts and sands of the London Clay Formation. This formation is described as poorly laminated, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. The London Clay is not a productive unit. There may also be thin beds of pockets of sand in the area. There are also areas of sandstones of the Bagshot Formation in the area, although not within the site boundary.

2.4.5 The Chalk lies underneath the London Clay. This is the major aquifer of southern and eastern England, with yields of around 150 l/s. Fractures are most dense and enlarged in the top 80 – 100m of the aquifer. Bedrock geology is displayed in Figure 5.

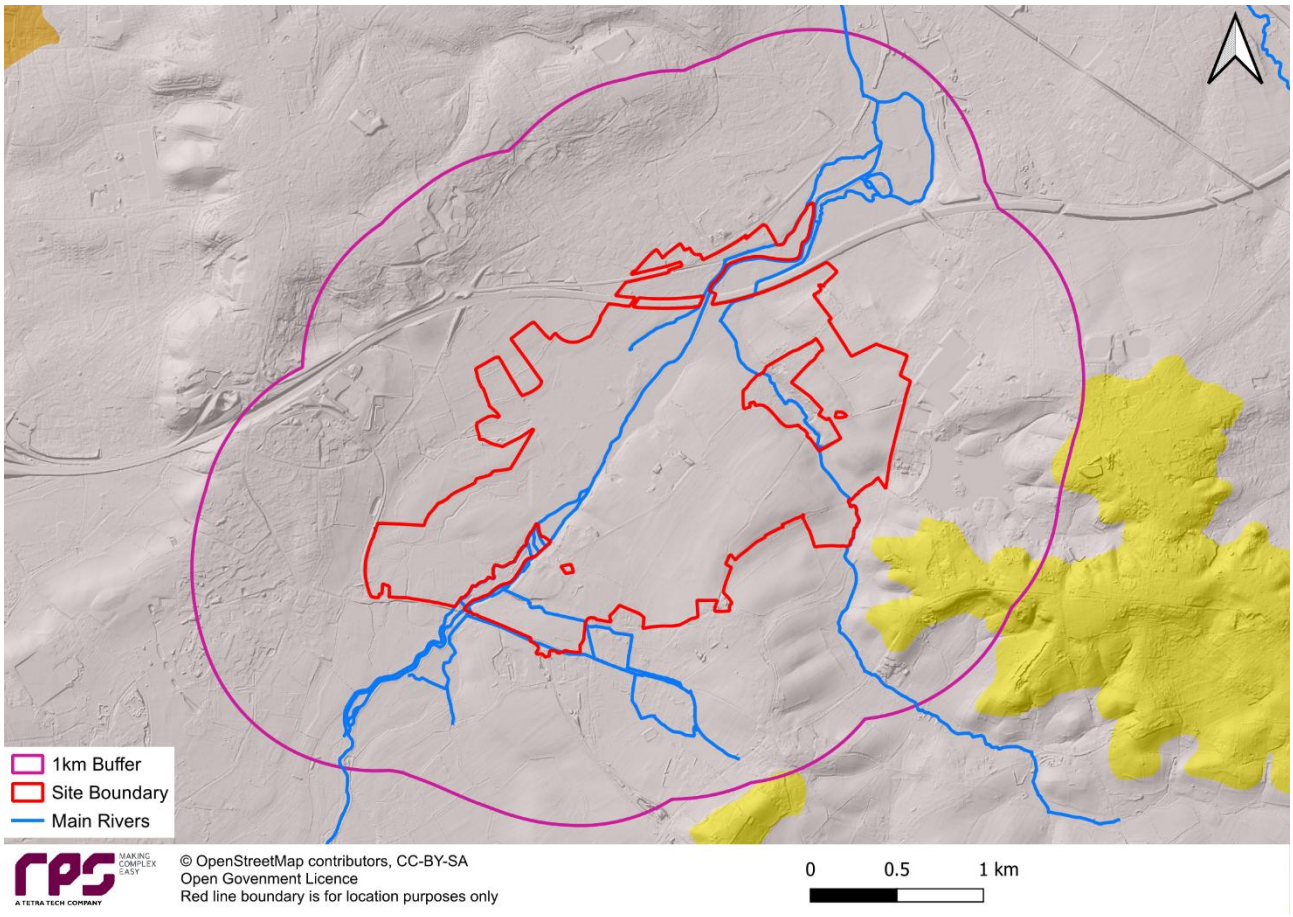

Figure 5 - Bedrock Geology

2.5 Hydrogeology

2.5.1 The BGS Hydrogeological Map of the Southwest Chilterns and the Berkshire and Marlborough Downs (BGS, 1978) shows the direction of groundwater movement at the site is to the northeast. This is in line with topography and the local surface water flow of the Loddon, towards the Thames.

2.5.2 The Chalk Aquifer is the major aquifer unit in the area, being targeted by a number of Private Water Supplies (PWS) (see Table 1). However, the London Clay is estimated to be approximately 27m thick in the area and will act as an aquitard which will prevent the transport of groundwater in the area to the Chalk. The Chalk itself outcrops just north of Reading, some 6km northwest of the site, where it recharges.

2.5.3 Groundwater will be present in some of the superficial deposits on site, however the distribution of wetlands, and the lack of perennial watercourses in most areas of the site suggest superficial groundwater flow paths are short and relatively isolated, only interacting with receptors such as wetlands within the floodplain of the Loddon.

2.5.4 To ensure private water supplies not recorded in local authority databases were included in this assessment, potential private water supply users (sites such farms, garden centres and industrial sites) within the survey area were contacted. This exercise did not identify any additional private water supplies.

Table 1 - Private Water Supplies with the Survey Area

Licence Number	Licence Holder	Aquifer Unit	National Grid Reference	Purpose
28/39/24/0014	Thames Water Utilities Ltd	Chalk Group	SU7468	Potable Water Supply - Direct
28/39/24/0200	RFC Bearwood Limited	Surface Water (Bearwood Lake)	SU7707168740	Spray Irrigation - Direct
28/39/24/0236/R01	NIRVANA SPA AND LEISURE LTD	Chalk Group	SU7730069712	Sports Grounds/Facilities
28/39/24/0251/R01	WARD WILSON INVESTMENTS LTD	Surface Water (Bearwood Lake)	SU7756068400	Spray Irrigation - Storage
28/39/24/0255/R01	University of Reading	Chalk Group	SU7550068500	General Farming & Domestic
TH/039/0024/008	THE ENVIRONMENT AGENCY	Surface Water (River Loddon)	SU7468767991	Transfer Between Sources (Post Water Act 2003)
TH/039/0024/036	RFC Bearwood Limited	Chalk Group	SU7698468987	Spray Irrigation - Direct

3 CONCEPTUAL MODEL

3.1.1 Groundwater flow pathways in the superficial deposits, particularly the alluvium within the site boundary and in the wider survey area flow with topography towards the Loddon or towards Barkham Brook in the Southeast.

3.1.2 Due to the isolated nature of the superficial deposits, flowpaths are not likely to extend more than around 1.5km. Year-round interface between groundwater and surface water receptors such as wetland only appears to occur within the floodplain of the Loddon, and which is mainly in the northern section of the site.

3.1.3 The bedrock groundwater system is concentrated within the chalk formation (Principal Aquifer), which supports several private water supplies within the survey area (see Table 1). Flow within the chalk is to the Northeast, in line with regional topography.

3.1.4 The chalk within the survey area is entirely overlain by the London Clay formation with a thickness of averaging 27 meters within the survey area. The London Clay is an aquitard and will therefore provide a barrier between the chalk and the development site.

3.1.5 The small extent of Bagshot Beds (Secondary (A) Aquifer) within the survey area is significantly up gradient of the site and is therefore unlikely to interact with the proposed works.

4 SENSITIVITY & RISK ASSESSMENT

4.1 Sensitivity

4.1.1 To assess risk to groundwater receptors, a sensitivity rating has been applied to each receptor according to the criteria set out in Table 2. The sensitivity ratings, along with justification are set out in Table 3.

Table 2 - Sensitivity Criteria

Sensitivity Rating	Description
Very High	• Groundwater aquifer(s) with very high productivity or Water Framework Directive (WFD) good groundwater quality and quantity status. Exploitation of groundwater resource is extensive for public, private domestic and/ or agricultural use (i.e. feeding ten or more properties) and/ or industrial supply. • Important sites of nature conservation dependent on groundwater or groundwater is considered likely to support wetland vegetation which is highly groundwater dependent. • Surface water features with hydrological importance to designated sensitive ecosystems of national/ international importance
High	• Groundwater aquifer(s) with moderate/ high productivity or WFD good groundwater quality and quantity status. Exploitation of groundwater resource is not extensive (i.e. private domestic and/ or agricultural supply feeding less than ten properties). • Local areas of nature conservation dependent on groundwater or groundwater is considered likely to support wetland vegetation which is moderately groundwater dependent. • Surface water features with hydrological importance to sensitive ecosystems of regional importance.
Medium	• Groundwater aquifer(s) with low productivity or WFD variable groundwater quality and quantity status. No current known exploitation of groundwater as a resource and aquifer(s) properties make potential exploitation appear unlikely. • Minor areas of nature conservation with a degree of groundwater dependency. • Surface water features with some but limited hydrologic importance to sensitive or protected ecosystems of authority area importance.
Low	• Groundwater aquifer(s) with very low productivity or WFD poor groundwater quality and quantity status. No known past or present exploitation of groundwater aquifer(s) as a resource. • Areas of vegetation with no groundwater dependency. • Surface water features with minimal/insignificant hydrological importance to sensitive ecosystems of less than authority area importance.

Table 3 - Sensitivity Ratings

Name	Type	Sensitivity	Justification
River Loddon	Main River	Very High	Major watercourse that supports local ecosystems as well as designated sensitive ecosystems of national importance including Lodge Wood & Sandford Mill SSSI.
Barkham Brook	Main River	Medium	Established perennial watercourse that supports flow in the River Loddon
“Long Ten”	Main River	Medium	Perennial watercourse that supports wetland habitats.
“The Dell” Watercourse	Main River	Low	Seasonal flood channel with no morphological regime, does not support watercourse ecology.
Field Drains	Ordinary Watercourse	Low	Agricultural ditches, most of which are seasonally dry and do not support watercourse ecology. Only active during flood events.
Loddon Floodplain Wetlands	Wetlands	Very High	Wetlands all intersect with superficial aquifers and appear to be highly groundwater dependant during dry periods.
Bearwood Lakes	Lakes	Low	Lakes on golf course with significant artificial influence, limited hydrological importance to ecosystems.
Arborfield Ponds	Ponds	Low	Artificial SuDs/ornamental ponds with limited ecological importance. Limited groundwater dependency where lined or situated on London Clay
Spring Near Shinfield Studios	Spring	Low	No clear connection to perennial watercourses or water dependant ecological features.
Spring Near Bearwood Lakes	Spring	Low	No clear connection to perennial watercourses or water dependant ecological features.
Alluvium Aquifer	Superficial Aquifer	High	Good productivity (Secondary A) and feeds surface water features including river Loddon, supports wetland features. Not known to be exploited for water supply.
River Terrace Deposits Aquifer	Superficial Aquifer	Low	Good productivity (Secondary A), does not support watercourses, wetland ecosystems, or private water supplies.
Bagshot Beds Aquifer	Bedrock Aquifer	High	Good productivity (Secondary A) and Good WFD Status, known to support private water supplies and watercourses.
Chalk Group Aquifer	Bedrock Aquifer	Very High	Very good productivity (Principal Aquifer) and known to support watercourses, wetland features. Several private water supplies in the area draw from the Chalk Group.

4.2 Risk Assessment

4.2.1 A risk assessment to quantify the potential effects of the proposed development on groundwater and other water environment receptors using the Source-Receptor-Pathway (SPR) framework. The key components of the framework are:

- **Source:** The origin of the contaminant or effect, such as a leaking fuel tank or reduced water levels.
- **Pathway:** The pathway through which the source will reach the receptor, in this case groundwater flow paths.
- **Receptor:** Components of the water environment that could be harmed, such as wetlands, watercourses or private water supplies.

4.2.2 The risk assessment considers the likely severity that each effect may have on ground and surface water quality at the receptors. Table 4 outlines the qualitative risk rating based on the likelihood of an S-P-R linkage existing, and the severity of the consequence should that pathway exist.

Table 4 - Qualitative Risk Matrix

Qualitative Risk		Severity of Consequence if pathway exists			
Matrix		**Severe**	**Medium**	**Mild**	**Negligible**
Probability that Hydrogeological Pathway Exists	**Highly Likely**	Very High Risk	High Risk	Moderate Risk	Low to Moderate Risk
	Likely	High Risk	Moderate Risk	Low to Moderate Risk	Low Risk
	Low Likelihood	Moderate Risk	Low to Moderate Risk	Low Risk	No Risk
	Unlikely	Low to Moderate Risk	Low Risk	No Risk	No Risk
	No Pathway	No Risk	No Risk	No Risk	No Risk

4.2.3 The risk ratings based on the above framework are outlined in Table 5 along with justification for probability and severity ratings assigned to each receptor.

Table 5 - Risk Ratings

Name	Type	S-P-R Linkage?	Severity of Consequence	Risk Class	Justification
River Loddon	Main River	Low Likelihood	Mild	Low Risk	The river Loddon is in clear interface with the water bearing superficial deposits within its floodplain, particularly the alluvium. However, the link is less clear between the alluvial aquifer and the parts of the site where development will take place. Recharge diverted from the superficial deposits by the drainage system will be routed to the river, therefore there will be no reduction in flow.
Barkham Brook	Main River	Low Likelihood	Mild	Low Risk	Barkham Brook is in clear interface with the water bearing superficial deposits within its floodplain, particularly the alluvium. However, the link is less clear between the isolated river terrace deposits around the parts of the site where development will take place. Recharge diverted from the superficial deposits by the drainage system will be routed to the watercourse, therefore there will be no reduction in flow.
“Long Ten”	Main River	No pathway	Mild	No Risk	The “Long Ten” watercourse is fed by groundwater from the superficial deposits and from inundation during flood events but any conceivable pathway through the superficial deposits between the development area and the watercourse is disrupted by the river Loddon.
“The Dell” Watercourse	Main River	Low Likelihood	Negligible	No Risk	“The Dell” watercourse likely interfaces with superficial deposits however the watercourse functions only as a seasonal flood channel so does not support regular watercourse ecology or a morphological regime. Recharge diverted from the superficial deposits by the drainage system will be routed to the river, therefore there will be no reduction in flow.
Field Drains	Ordinary Watercourse	Likely	Negligible	No Risk	Field drains on the site interface with superficial deposits however the vast majority act as seasonal flood channels and therefore do not support watercourse ecology. The small areas of field drain that are filled year-round are the other side of the river Loddon to the development area.

Loddon Floodplain Wetlands	Wetlands	Likely	Mild	Low to Moderate Risk	Wetlands around the Loddon are fed by groundwater from the surrounding alluvial aquifer and from inundation during flood events. Development is to be steered outside of the floodplain and therefore the alluvial aquifer. Drainage system will outfall to the Loddon meaning water levels will be maintained in the alluvial aquifer.
Bearwood Lakes	Lakes	No Pathway	Medium	No Risk	No reasonable hydrogeological pathway between development and Bearwood Lakes as they are up gradient and sit on the London Clay.
Arborfield Ponds	Ponds	No Pathway	Mild	No Risk	No reasonable hydrogeological pathway between the development and Arborfield Ponds. Ponds sit on the London Clay or are lined where they sit on superficial deposits.
Spring Near Shinfield Studios	Spring	No Pathway	Mild	No Risk	Potential hydrogeological pathway between the spring and the development is blocked by the river Loddon.
Spring Near Bearwood Lakes	Spring	No Pathway	Mild	No Risk	No reasonable hydrogeological pathway between development and the spring as it is up gradient and sits on the London Clay.
Alluvium Aquifer	Superficial Aquifer	Likely	Mild	Low to Moderate Risk	Pathway likely exists between the development and the alluvial aquifer, however the drainage system will outfall to the Loddon meaning water levels will be preserved.
River Terrace Deposits Aquifer	Superficial Aquifer	Highly Likely	Negligible	Low to Moderate Risk	Development area is on the River Terrace Deposits to the south of the Loddon, however there is no evidence that the RTDs support private water supplies, watercourses or wetland ecosystems.
Bagshot Beds Aquifer	Bedrock Aquifer	No Pathway	Medium	No Risk	No reasonable hydrogeological pathway between the development and the Bagshot Beds Formation as it is up gradient and separated by the London Clay.
Chalk Group Aquifer	Bedrock Aquifer	No Pathway	Severe	No Risk	No reasonable hydrogeological pathway between the development and the Chalk Aquifer, London Clay forms an aquitard and is approximately 27m thick in the development area.

4.3 Mitigation Measures

4.3.1 The low to moderate risks of adverse effects identified in Table 5 can be controlled with basic mitigation measures in line with construction best practice. These measures are detailed below:

- Best practice measures should be put in place to control pollution, particularly from fuels and oils during construction. A pollution prevention plan (PPP) should be established to outline methods for controlling groundwater pollution risk.
- Basic groundwater level monitoring should be in place during construction with a response zone at least 1 meter below the deepest excavation level. Where groundwater is identified that may intersect with excavations, this should be managed in line with construction best practice measures. Any discharge/abstraction licenses required for this management should be obtained prior to excavation.
- Where any excavation and replacement of material is necessary within the floodplain of the River Loddon or Barkham Brook, for example during the construction of roads, replacement material should replicate the hydraulic characteristics of the excavated material.

5 SUMMARY & CONCLUSIONS

5.1.1 RPS has been commissioned to prepare a hydrogeological conceptual model and risk assessment to quantify the impact on water environment receptors of a residential development being promoted by Savills at Hall Farm near Reading.

5.1.2 The proposed works are for a residential and mixed-use development which is expected to be comprised of up to 2,800 dwellings. The site covers a large area of agricultural land in the Loddon valley; however, the residential and commercial development area is situated on the south side of the Loddon to avoid flood risk constraints.

5.1.3 A hydrogeological conceptual model and risk assessment has been produced based on information published by the British Geological Survey among other providers as well as a walkover of the site and receptors within 1km in early June 2025.

5.1.4 The site is currently fairly flat lying agricultural land that drains to the Loddon, a major main river and in places to Barkham Brook, a tributary of the Loddon. Smaller watercourses on the site take the form of seasonal drainage ditches that are usually only active during flood events.

5.1.5 Several areas of wetland, including marshes and wet woodland were identified in the floodplain of the Loddon during the walkover survey, these appear to be supported by superficial groundwater and by inundation during flood events. Some ponds, including the large lakes at Bearwood to the east of the survey area were identified. Most of the ponds sit on the London Clay or are lined where situated on more permeable superficial deposits.

5.1.6 Superficial deposits cover most of the site area and include alluvium and river terrace deposits surrounding the major watercourses and some small areas of gravel and head to the west and east of the site, respectively.

5.1.7 Bedrock geology at the site is dominated by the London Clay formation which is underlain by formations of the Chalk Group at depth. Thickness of the London Clay on the site is approximately 27 meters.

5.1.8 Groundwater is present on the site, particularly in the alluvium of the Loddon floodplain where is supports wetland ecosystems. The superficial deposits are not known to support ecosystems outside of the Loddon floodplain or any private water supplies. The isolated nature of the superficial deposits means flow paths are relatively short.

5.1.9 Groundwater receptors identified during the desk study and walkover survey have been assessed against a standard sensitivity criteria to quantify the severity of adverse effects. Each receptor was then risk assessed using the Source-Pathway-Receptor framework.

5.1.10 Most receptors were judged to be at low risk from adverse hydrogeological effects from the development, owing to the isolated nature of water bearing deposits, and the location of the development areas away from the Loddon floodplain in which the most sensitive receptors are situated.

5.1.11 Wetlands around the Loddon, and the superficial aquifers of the Alluvium and River Terrace Deposits were assessed as having low to moderate risk of adverse hydrogeological effects from the development. This risk can be managed through construction best practise measures, basic groundwater monitoring and the selection of appropriate material where excavate and replace occurs in the floodplain of watercourses.